STRATAFORM PLUME STUDY AND LEO-15 ANALYSES

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LONG TERM GOALS

The overall goal of our research effort is to understand (1) the processes which govern sediment transport in the bottom boundary layer (including suspended, bedload and bedform transport), (2) the relationship of suspended and bedload transport to the bedforms and wave and current forcing, and (3) how these affect strata formation on the continental shelf. With a combined observational and theoretical approach, data is being obtained to improve models of suspended and bedload transport which will allow better predictions of sediment and contaminate transport. Our goal in STRATAFORM is to advance the understanding of the bottom sediment transport processes (resuspension and transport as suspended sediment and movement along the bottom in bedforms) and improve modeling of sediment transport, particularly the movement in the bottom meter of the water column, related to the cross shelf movement and deposition of sediment from the Eel river.

SCIENTIFIC OBJECTIVES AND APPROACH

In order to understand sediment transport processes, a wide variety of simultaneous measurements of sediment concentration, movement and physical forcing must be made. Our approach has been to use new and innovative instrumentation to make these observations in the bottom boundary layer to improve our understanding of the processes occurring there. In the past three years, we have participated in two such programs making such measurements: STRATAFORM and LEO-15 (the latter was co-funded by NOAA/NURP through Rutgers University.) In these programs, Acoustic Backscatter Systems (ABS's) at several frequencies, a rotating sector scanning sonar (SSS), laser diffraction particle sizers (LISST's), Optical Backscattering Sensors (OBSs), current meters and bottom pressure instrumentation were deployed along with the instrumentation of other investigators to study the sediment resuspension and transport processes.

In STRATAFORM, our objective is to improve our understanding of the continental-margin stratagraphic evolution off the Eel River on the Northern California

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Shelf and quantify the storm/flood induced river plume sedimentation processes. To understand these processes, one deployment was made of our acoustic (ABS and SSS) and optic (LISST) instruments from January to April 996. The deployment was made in 50 m of water on the USGS GEOPROBE tripod. The instruments returned with an excellent data set, much of which we have analyzed in the past year, with the initial emphasis on the sector scanning sonar record. This instrumentation is again being deployed in Nov. 1997 through March 1998 in an across array of bottom tripods at 20, 40 and 60 meters depth along the STRATAFORM K-line to observe the processes and transport of sediment in the bottom boundary layer in relationship to the Eel river plume. Also moorings at these three sites will monitor the temperature salinity and optical backscattering to determine when the plume passes these sites, and LISST sensors will determine the plume sediment size distribution and concentration.

At LEO-15 our objective was understanding the interactions between bedload transport and suspended sediment transport, using our acoustic instruments (ABS and SSS) to provide the primary data needed to observe both processes. The 1995 deployment at the LEO-15 site (off Atlantic City, New Jersey) provided good data for this study, which has been analyzed by AASERT student Peter Traykovski as part of his Ph.D. thesis. By looking at bedform migration and suspended load transport, we can get an idea of which processes dominate, and the detailed processes occurring due to combined wave and current forcing.

RESULTS

In STRATAFORM, we obtained a two month long, hourly sampled time series of sector scanning sonar (SSS) images of the bottom microtopography which allowed us see, for the first time, the evolution of the bottom *during* a storm/transport event. The average size of the sediment and the typical stresses exerted indicate that the bottom microtopography should be dominated by anorbital ripples of about 10 cm wavelength, and indeed that is what was observed. Very little wavelength change is noted during storm events, again in agreement with theory; the direction of the ripples during storm events is seen to follow the wave direction, though with a small time lag. ABS altimetry of the bottom indicated that larger scale features were also moving through the area of the tripod, which agrees with the GEOPROBE altimeter measurement. Analysis of ABS records showed interesting near bottom structure in the sediment transport during storm events, which will be pursued further in the coming year.

The 1995 LEO-15 measurements produced six week long time series of ABS, SSS, current meter, and other measurements. Analyses of these data have shown that large wave orbital ripples are migrating onshore at a rate of up to 80 cm/day. The suspended sediment transport measured by the ABS and current meters is in the opposite direction and unable to account for the size and migration rate of these ripples, implying that unobserved bedload transport is the dominant transport mechanism at LEO-15. This direct contrast of ripple migration transport and suspended sediment transport clearly shows the need for better near bed suspended and bedload transport measurements in order to understand bottom microtopographical structure and net sediment transport.

IMPACT/APPLICATIONS

The STRATAFORM and LEO-15 work to date has shown that wave dominated bottom microtopography on the shelf can probably be predicted reasonably at a spectral level, simply by using bottom grain size information and estimates of the surface wave field, although the existing models have not been entirely adequate to do this. While this is not a new concept, the verification of the concept *during* storm events, and not just before and after, has had to wait until the autonomous SSS technology was available. The LEO-15 work has also demonstrated the potentially great importance of measuring bedload transport routinely; simple suspended transport measurements and models can easily underestimate the total sediment transport and thus be inaccurate in many coastal applications.

TRANSITIONS

The autonomous sector scanning sonar system we have developed (based on Alex Hay's original cabled system) has been documented in an article submitted to a refereed journal, which should allow others to use this technology fairly easily. We have already had some requests to supply this documentation to potential users.

RELATED PROJECTS

We have been involved in the past, and hope to be involved in future NOAA/NURP observations of suspended and bedload transport, and the 3-D nature of the suspended sediment structure at the LEO-15 site off New Jersey. These observations will help us understand the suspension and transport of sediment as suspended sediment, as bedload and bedform movement.

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[6] WWW address for additional results on acoustic monitoring of sediment transport (including some movies of ripple movement) at STRESS (northern California Shelf) and LEO-15 see : "http://www.aol.whoi.edu".